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nrri

August 14, 2019

Jocelyn Boyd
Executive Director
Public Service Commission of South Carolina
101 Executive Center Drive, Suite 100
Columbia, South Carolina 29210

Dear Executive Director Boyd,

Thank you for your interest in NRRI's ability to provide the South Carolina Commission with assistance in implementing Act 62. Please let the Commissioners know that I appreciate their courtesy and their insightful questions. I look forward to providing them with the technical assistance required.

The questions that need to be addressed are important to the people and economy of South Carolina. The time horizon is short. We are prepared to hit the ground running and to complete this task rapidly and objectively.

With respect to the tasks required to establish avoided cost based rates, NRRI will assist the commission by:

- reviewing the filings submitted by the utilities next week and preparing and submitting discovery requests quickly;
- developing an independent analysis and critique of the underlying rationale for the methods supported by the utilities and intervenors;
- evaluating the veracity of the production cost results used to support the utilities' filings, as well as directing the utilities to provide necessary alternative analyses;
- developing new methods for establishing avoided cost based rates as warranted (e.g., using the National Energy Modeling System (NEMS);
- presenting our results in oral and written testimony;
- drafting purchase power agreements, briefs, and commission orders in conjunction with the Commission and its staff.

On Monday, we discussed a variety of issues related to the use of production cost models. It is clear that the Commission is interested in engaging a consultant with significant expertise and experience with the use of those models. While I have extensive experience with production costing models, I am pleased to let you know that Eric Krall of OnLocation has agreed to join our team. Eric was a colleague of mine at the FERC, where he was responsible for running and overseeing directing the group that ran PROMOD. As you can see from his attached resume, he has a tremendous depth and breadth of modeling experience. Given the importance of this project, his firm is willing to make a substantial commitment of his time to this project. In addition Lessly Gourdarzi, OnLocation's Founder and CEO has made himself available for this project (see his letter and firm's credentials are attached). Les has a reputation as a creative modeler. The quality of OnLocation's work is reflected in the fact that the firm runs the NEMS for the National Labs.

I appreciate the Commission's concern over potential conflicts of interest. I have requested my research staff, NRRI's fellows who would contribute to the project, and OnLocation to review the list of parties provided to us yesterday by Afton Ellison. As you can see from the attached responses, none of the members of our team have any direct conflicts. Dr. Neenan did some work for Southern Carolina Gas and Electric on electric rates in the early 1990's and, while at the Electric Power Research Institute, worked with Duke researchers on Smart Grid projects. EPRI maintains strict rules that prohibit its researchers from being involved in either policy or ratemaking issues. As a consequence, we believe that you will agree that Dr. Neenan has no conflict.

Thank you again for your interest in NRRI's assistance. We appreciate the magnitude of the task before the Commission and look forward to working with you.

Sincerely,

Carl Pechman

Carl Pechman, Ph.D.
Director

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OnLocation

August 14, 2019

Dr. Carl Pechman, Director
National Regulatory Research Institute
1101 Vermont Avenue, NW
Suite 200
Washington, DC, 20005

Re: Consulting Support to NRRI South Carolina Energy Freedom Act (H.3659) Proceeding to Establish Standard Offer, Avoided Cost Methodologies in three proceedings

Dear Dr Pechman:

OnLocation, Inc., is pleased to be considered in support of your efforts in the referenced proceedings. Attached you will find a brief introduction to OnLocation, short bios of Mr. Krall and Goudarzi and, by way of background, an overview of some of the integrated modeling capability we typically utilize in support of our clients. You will also find Mr. Krall's resume attached.

In support of your efforts, we can commit up to 60% or Mr. Krall's time and if needed, up to 15% on Mr. Goudarzi's. If required on a short term surge basis, we can exceed those limits.

We have reviewed the list of participants in the proceedings and do not believe we have any conflicts of interest.

Also attached is OnLocation's professional rate schedule. It is our understanding that depending on the needs of the work, we can assign additional staff beyond Mr. Krall and Goudarzi. Mr. Krall would be billed as Subject Matter Expert I and Mr. Goudarzi as Principal.

Please feel free to contact me for any additional information that may be required.

Sincerely,

Lessly A. Goudarzi
CEO, Founder

Suite 300 501 Church Street, NE Vienna, VA 22180 Phone: (703) 938-5151 Fax: (703) 938-6143

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OnLocation's Consulting Support to NRRI's Participation in the South Carolina Energy Freedom Act (H.3659) Proceeding(s) to Establish Standard Offer, Avoided Cost Methodologies (Dockets 2019-184-E, 2019-185-E, 2019-186-E)

Introduction to OnLocation

OnLocation/Energy Systems Consulting is recognized as a leading energy consultant providing objective quantitative analysis to a diverse set of energy policy stakeholders. Since 1984, OnLocation has served a broad range of government and industry clients with a common interest in energy and the environment.

OnLocation's experienced professionals rely on thorough research and analysis to achieve practical and customized solutions for our clients. To help our clients understand the implications of the challenges facing our energy system, we develop, modify and apply a variety of computer models to examine potential energy trends, impacts of proposed government policies and the associated financial and economic impacts of energy related investment decisions. Collectively, the staff of OnLocation has over 100 years of working experience with integrated energy models including the National Energy Modeling System (NEMS), EIA's widely recognized energy model. OnLocation's senior staff and associate consultants have provided insights and solutions to the business and policy challenges of the Department of Energy, Environmental Protection Agency, energy corporations and various non-governmental organizations that support policymakers in Congress and elsewhere.

Key Supporting Consultants

Eric Krall will act as the lead consultant. Mr. Krall is a Senior Consultant at OnLocation, Inc. He has over ten years of experience working on issues related to U.S. electric power markets. Prior to joining OnLocation, Mr. Krall held various positions in the federal government, including: Operations Research Analyst at the Federal Energy Regulatory (FERC), Team Leader for Electricity Analysis at the U.S. Energy Information Administration, and Branch Chief in the Market Oversight division of FERC's Office of Enforcement In addition, Mr. Krall served on a detail assignment from FERC to the Council on Environmental Quality where he focused on environmental policies affecting the U.S. power sector. He holds a B.S. in Engineering Science from Pennsylvania State University, an M.S. in Industrial Engineering and Operations Research from Pennsylvania State University, and an M.S. in Applied Economics from Johns Hopkins University.

His experience includes integrated energy systems modeling, power sector production cost modeling, analysis of RTO and ISO market rules and policy, and analysis of environmental regulations. His current work focuses on modeling the U.S. electric power sector using the National Energy Modeling System (NEMS) Electricity Market Module (EMM). Within the NEMS EMM framework, Mr. Krall formulates and develops approaches to modeling power sector capacity expansion, dispatch, and pricing models in support of long-term projections for OnLocation's clients. In this regard, he has performed modeling and analysis related to federal tax policies, existing nuclear power plants, carbon capture and sequestration for existing and new power plants, and renewable resources. Mr. Krall also works on long-term projection models related to power sector cooling water usage and carbon transport,

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utilization, and storage. In his prior positions, Mr. Krall gained experience working with production cost models. He is primarily familiar with PROMOD IV; he has also worked with UPLAN-NPM. Mr. Krall has worked with production cost models in both zonal and nodal configurations and has performed modeling of the Eastern and Western Interconnections. He is familiar with the use of these models to analyze wholesale market indicators including generator dispatch, locational pricing and transmission constraints. Mr. Krall also has experience with a wide range of other programming and software tools including Fortran, GAMS, AIMMS, Python, and SAS.

Less Goudarzi will contribute to the assessment of alternative methodologies and as a QA/QC reviewer of all OnLocation products. Mr. Goudarzi is the Founder and CEO of OnLocation, Inc., a management consulting firm providing technical, economic and financial counsel in both the private and public sectors. He has over forty years of experience in management consulting including a wide variety of project specific, industry wide, integrated regional, national and international energy and environmental policy analyses.

Mr. Goudarzi has spent a large portion of his career assisting public and private sector clients create the quantitative tools required to address structural and regulatory challenges in the energy industry. His current interests are in the structural and economic challenges associated with the surging supplies of domestic oil and natural gas, the technology challenges associated with climate change (specifically including carbon capture, transport and storage) and the continued pressure on the power industry associated with environmental regulations. His recent clients include the Environmental Protection Agency, the Department of Energy, the Energy Information Administration, the National Energy Technology Laboratory and a number of private companies and NGOs with continued interest in domestic energy and environmental policy and specifically, climate change policies.

Mr. Goudarzi has an MBA concentrating in Management Science from Virginia Tech and received his B.A. from Wittenberg University where he majored in Economics and Business Administration. He is a member of Beta Gamma Sigma.

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Selective Overview of OnLocation's Modeling Experience and Capability

The following section highlights the extensive experience OnLocation has employing the National Energy Modeling System (NEMS) in analyzing energy and environmental policies. This experience extends beyond merely using the model—OnLocation has contributed to the design and implementation of NEMS on behalf of the Energy Information Administration (EIA) and other federal, public sector, nonprofit, and private clients for over 25 years, including customizing the model to analyze specific policy issues and proposals. OnLocation contributed to the early implementation of NEMS and has for every year since assisted EIA in its maintenance, updates and enhancing its capability.

Key features of NEMS that can addresses many of our clients modeling needs regarding renewable energy projections, climate change policies and energy forecasts in general:

- Integrated energy model that includes all aspects of the U.S. energy system
- Annual energy projections through the year 2050
- Detailed fuels, electricity, and end-use demand sector representation
- Widely used by public and private sector for energy and environmental policy analysis and relevant for national policy development
- Significant resources dedicated to its review, maintenance, and updates on an ongoing basis

NEMS has been used by the EIA and others, both within and external to the government, for forecasting, planning and policy evaluation since 1994. Through its production of the Annual Energy Outlook reports as well as special studies, EIA keeps the data sources and model capabilities up-to-date to reflect the latest energy issues, trends, and policies. This allows OnLocation to examine and understand energy forecasts and their key drivers, build on the model's foundation, and customize the model to analyze specific policy issues and proposals. Having participated in a wide variety of analyses using NEMS for multiple clients, OnLocation has developed a seasoned perspective on the elements of long-term forecasting that impact analytic results.

Power Sector Modeling, Analysis, and Assessment

The electric generation sector is one of the most detailed and data rich modules within NEMS and can be used to analyze a broad range of policies within the power sector. The NEMS model includes a database of detailed information on individual power plants throughout the country, including operating costs and characteristics, plant configurations of installed environmental control equipment, and average emission rates for SO_2, NOx and mercury. The model also includes costs and characteristics for several compliance options available for power plants to

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meet air quality regulations. Compliance options include fuel switching to lower sulfur coal types, retrofit equipment options for all three pollutants, and a flexible cost-based dispatch algorithm. The model uses financial criteria to choose among these options or choose to retire a plant, considering the plant's heat rate, operating costs, system capacity reserve requirements and future fuel prices.

NEMS is also frequently used to analyze the impacts of policies to deploy clean energy technologies and reduce CO2 emissions. Studies performed by OnLocation range from specific proposed legislation of cap-and-trade policies, clean energy standards (CES), renewable portfolio standards (RPS), and clean energy incentives, as well as more explorative versions of these policies. CO_2 cap-and-trade policy options and specifications include an annual CO_2 allowance cap (economy-wide or by sector), allowance banking, marginal abatement curves and limits for both domestic and international CO_2 offsets, revenue recycling options, and allocation vs. auction of allowances. Model features designed for clean energy standards and renewable portfolio standards include an annual target expressed in percent of electricity sales, credit banking, and options for determining which technologies qualify for the program.

The Electricity Market Module (EMM) in NEMS consists of four sub-modules: the Electricity Capacity Planning Model (ECP), the Electricity Fuels and Dispatch Model (EFD), the Electricity Finance and Pricing Model (EFP) and the Load and Demand Side Management Module (LDSM).

The EMM projects new generation capacity, environmental control retrofits needed to meet current and proposed environmental regulations, and dispatch of generation and electricity prices for 22 NERC-based electricity regions. The model starts with a detailed database that includes key economic and technical performance characteristics (e.g., heat rates, capacity, pollution control technologies and emission rates, operating costs, etc.) of ***all*** existing power plants/units. In addition, the EMM is initialized with selected financial data that allows the estimation of cost-of-service based electricity prices in those regions where this is relevant. Given these initial conditions, the ECP assesses the need for new capacity in the context of the forecasted economic and regulatory environment. The EFD plant-level generation (i.e., unit dispatch) given the fuel and variable O&M costs, the relative efficiencies of the generating technologies, and the costs of meeting various environmental constraints (e.g., emission allowances). The EFP estimates the retail price of electricity under competitive market (marginal costs) and cost-of-service pricing regimes. The LDSM constructs load duration curves used by the ECP and EFD from the end-use demand levels estimated in other NEMS modules.

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Selected highlights of the EMM include:

- Constructs new capacity on a yearly basis to meet growing demand and reserve margin requirements, and chooses technologies appropriate for meeting future environmental and other policy requirements.
- Incorporates a market sharing algorithm to address cost uncertainty among a wide slate of competing technologies.
- Explicitly considers retrofits of pollution control technologies to existing plants as well as alternatives such as fuel switching or plant retirement to meet emission constraints, and provides detailed outputs regarding emissions (SO2 NOx, CO2).
- Explicitly considers expanding transmission interfaces between regions to allow for the greater use and sharing of regional energy potential (e.g., wind resources).
- Explicitly adjusts capacity needs for increased penetration of intermittent renewable generation.
- Accommodates different assumptions across a broad range of key factors, such as electric generating technology costs, end-use energy demand, fuel prices, etc.
- Explicitly addresses component learning on key electric generating technologies.
- Explicitly models the transport and storage of captured CO2 to saline storage (with detailed site-specific costs of storage).

OnLocation played a pivotal role in the design and implementation of the original EMM. In our ongoing role as support contractor to EIA, we continue to make major contributions to improving technology representation and extending the EMM's ability to address the evolving state and national policy initiatives along with market and operational issues facing the power industry. For example, we incorporated spinning reserve requirements and heat rate curves for coal where the efficiency declines with lower usage.

One the most recent enhancements to the EMM is the inclusion of utility scale storage that is challenging to represent in large scale models. OnLocation provided EIA with an innovative solution to the representation of battery storage within the EMM context where a high temporal resolution is not feasible. Rather than expanding the number of representative load slices in the entire capacity expansion and dispatch routines, a new submodule was created. This submodule performs an hourly dispatch using data provided by the rest of the EMM including hourly load requirements, wind and solar generation patterns hydroelectric capacity and monthly generation potential, and cost of conventional power generation. The dispatch is performed with existing storage and then with additional storage to determine the arbitrage value of storage, wind and solar curtailments and the timing of hydrogenation. These values are passed back to the EMM to inform the capacity expansion and final dispatch decisions.

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ERIC A. KRALL
Senior Consultant

EDUCATION

2015	Johns Hopkins University, Washington, DC – M.S., Applied Economics
2006	Pennsylvania State University, University Park, PA – M.S., Industrial Engineering and Operations Research
2003	Pennsylvania State University, University Park, PA – B.S., Engineering Science; minor in Electronic and Photonic Materials

EMPLOYMENT HISTORY

11/2018-Present	OnLocation, Inc., Senior Consultant, Vienna, VA
2015-2018; 2008-2014	Federal Energy Regulatory Commission, Washington, DC 2017-2018, Supervisory Energy Industry Analyst 2008-2014; 2015-2017, Operations Research Analyst
2016-2017	Council on Environmental Quality, Deputy Associate Director for Energy & Climate Change, Washington, DC
2014-2015	U.S. Energy Information Administration, Supervisory Operations Research Analyst, Washington, DC

SELECTED PROJECT EXPERIENCE

Experience Summary

Mr. Krall has over 10 years of experience in energy market analysis and modeling. He has worked on and numerous projects concerning electric power markets, economic regulation of electric utilities, environmental policies affecting the power sector, and quantitative analysis of these topics. His specialty areas include optimization models (particularly of electric power markets), economic analysis of electric power markets, data analysis, and data visualization.

Project Summaries

Integrated Energy Modeling

At OnLocation, Mr. Krall has worked on National Energy Modeling System (NEMS) model development for several projects related to the electric power sector, including analysis of policies and issues related to nuclear, coal-fired, natural gas-fired, and renewable generation. In this regard, Mr. Krall has worked on capacity expansion models, dispatch models, and pricing models in support of long-term energy projections. Specifically, he has conducted comprehensive modeling and analysis related to federal tax policies, existing nuclear power plants, carbon capture and sequestration for existing and new power plants, and renewable resources. Mr. Krall has also worked on modeling related to energy policies affecting the U.S. industrial sector. He has also conducted cost analysis and optimization modeling related to carbon transport, utilization and storage (CTUS) pipeline networks.

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As a Team Leader at EIA, Mr. Krall oversaw a team of modelers and analysts responsible for developing and reporting on the electric power-related components of EIA's projections. Example projects include: National Energy Modeling System (NEMS) model development and analysis for EIA's annual projections and requests for analysis of major proposed regulations and policies affecting the power sector.

Electric Sector and Utility Analysis

Mr. Krall has worked on a wide variety of analysis related to the electric power sector. As a Branch Chief in FERC's Office of Enforcement, Mr. Krall managed a team of economists and analysts responsible for monitoring and oversight of FERC-jurisdictional wholesale electricity markets operated by Regional Transmission Organizations and Independent System Operators (RTO/ISO). Mr. Krall oversaw the development of SQL-based analytic reports on the operation and performance of these markets. He also managed the production of several external-facing reports including the Markets and Summer Energy Market and Reliability Assessment; these reports informed the Commission and the public about developments, trends, and fundamentals affecting wholesale electricity markets. In addition, Mr. Krall served as a reviewer on draft Commission orders, especially those related to RTO/ISO market rules, market behavior, and market information.

From August 2016 to January 2017, Mr. Krall served on a detail assignment to the Council on Environmental Quality in the Executive Office of the President. In this role, Mr. Krall provided analysis and policy expertise regarding environmental policies and regulations affecting the U.S. power sector, as well as various energy-related White House initiatives.

Previously, Mr. Krall was an Operations Research Analyst at FERC. In this role, Mr. Krall conducted analysis involving a wide range of technical, economic, and policy issues, including: wholesale electricity market design, renewable electricity, demand response, transmission planning, open access transmission tariffs, and ancillary services markets. Mr. Krall also provided analytic and technical expertise on various Commission initiatives and proceedings, including: price formation in wholesale electricity markets, RTO and ISO market performance, and the five-year review of the Commission's oil pipeline index.

Unit Commitment and Economic Dispatch Modeling

As an Operations Research Analyst in FERC's policy office, Mr. Krall formulated, programmed, and analyzed linear and mixed-integer programming models of wholesale electricity market unit commitment and economic dispatch processes using GAMS. These models were used for various purposes, including: analyzing the performance of various algorithms for solving unit commitment problems and analyzing changes to model formulations.

Mr. Krall is also familiar with commercial off-the-shelf power sector production cost models. Specifically, he has performed production cost modeling using PROMOD-IV to analyze wholesale power market indicators in the Eastern and Western Interconnections under various transmission expansion scenarios. He has also worked with the UPLAN-NPM production cost model.

In addition, Mr. Krall has worked on published papers regarding the formulation of optimization models for unit commitment and transmission planning. He has presented to various audiences on topics related to optimization models for electricity markets.

Data Analysis and Data Visualization

At FERC, Mr. Krall led analysts in analyzing and visualizing data related to wholesale energy markets. Under Mr. Krall's supervision, analysts created tools using SAS, SAS Visual Analytics, and Python to

OnLocation

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retrieve data from databases and other sources, manipulate data, and create data visualizations with automated updates.

Mr. Krall has conducted numerous ad-hoc analyses using electricity market data, examining specific aspects of energy market results. Mr. Krall is highly experienced in using tools such as SAS, SQL, and R to conduct such analysis.

SELECTED PUBLICATIONS AND PRESENTATIONS

- "2018 Summer Energy Market and Reliability Assessment," manager of FERC staff report, May 2018.
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PROGRAMMING LANGUAGES

- GAMS, AIMMS, Fortran, R, Python, SAS

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Key Supporting Consultants

Eric Krall will act as the lead consultant. Mr. Krall is a Senior Consultant at OnLocation, Inc. He has over ten years of experience working on issues related to U.S. electric power markets. Prior to joining OnLocation, Mr. Krall held various positions in the federal government, including: Operations Research Analyst at the Federal Energy Regulatory (FERC), Team Leader for Electricity Analysis at the U.S. Energy Information Administration, and Branch Chief in the Market Oversight division of FERC's Office of Enforcement In addition, Mr. Krall served on a detail assignment from FERC to the Council on Environmental Quality where he focused on environmental policies affecting the U.S. power sector. He holds a B.S. in Engineering Science from Pennsylvania State University, an M.S. in Industrial Engineering and Operations Research from Pennsylvania State University, and an M.S. in Applied Economics from Johns Hopkins University.

His experience includes integrated energy systems modeling, power sector production cost modeling, analysis of RTO and ISO market rules and policy, and analysis of environmental regulations. His current work focuses on modeling the U.S. electric power sector using the National Energy Modeling System (NEMS) Electricity Market Module (EMM). Within the NEMS EMM framework, Mr. Krall formulates and develops approaches to modeling power sector capacity expansion, dispatch, and pricing models in support of long-term projections for OnLocation's clients. In this regard, he has performed modeling and analysis related to federal tax policies, existing nuclear power plants, carbon capture and sequestration for existing and new power plants, and renewable resources. Mr. Krall also works on long-term projection models related to power sector cooling water usage and carbon transport,

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utilization, and storage. In his prior positions, Mr. Krall gained experience working with production cost models. He is primarily familiar with PROMOD IV; he has also worked with UPLAN-NPM. Mr. Krall has worked with production cost models in both zonal and nodal configurations and has performed modeling of the Eastern and Western Interconnections. He is familiar with the use of these models to analyze wholesale market indicators including generator dispatch, locational pricing and transmission constraints. Mr. Krall also has experience with a wide range of other programming and software tools including Fortran, GAMS, AIMMS, Python, and SAS.

Less Goudarzi will contribute to the assessment of alternative methodologies and as a QA/QC reviewer of all OnLocation products. Mr. Goudarzi is the Founder and CEO of OnLocation, Inc., a management consulting firm providing technical, economic and financial counsel in both the private and public sectors. He has over forty years of experience in management consulting including a wide variety of project specific, industry wide, integrated regional, national and international energy and environmental policy analyses.

Mr. Goudarzi has spent a large portion of his career assisting public and private sector clients create the quantitative tools required to address structural and regulatory challenges in the energy industry. His current interests are in the structural and economic challenges associated with the surging supplies of domestic oil and natural gas, the technology challenges associated with climate change (specifically including carbon capture, transport and storage) and the continued pressure on the power industry associated with environmental regulations. His recent clients include the Environmental Protection Agency, the Department of Energy, the Energy Information Administration, the National Energy Technology Laboratory and a number of private companies and NGOs with continued interest in domestic energy and environmental policy and specifically, climate change policies.

Mr. Goudarzi has an MBA concentrating in Management Science from Virginia Tech and received his B.A. from Wittenberg University where he majored in Economics and Business Administration. He is a member of Beta Gamma Sigma.

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Selective Overview of OnLocation's Modeling Experience and Capability

The following section highlights the extensive experience OnLocation has employing the National Energy Modeling System (NEMS) in analyzing energy and environmental policies. This experience extends beyond merely using the model—OnLocation has contributed to the design and implementation of NEMS on behalf of the Energy Information Administration (EIA) and other federal, public sector, nonprofit, and private clients for over 25 years, including customizing the model to analyze specific policy issues and proposals. OnLocation contributed to the early implementation of NEMS and has for every year since assisted EIA in its maintenance, updates and enhancing its capability.

Key features of NEMS that can addresses many of our clients modeling needs regarding renewable energy projections, climate change policies and energy forecasts in general:

- Integrated energy model that includes all aspects of the U.S. energy system
- Annual energy projections through the year 2050
- Detailed fuels, electricity, and end-use demand sector representation
- Widely used by public and private sector for energy and environmental policy analysis and relevant for national policy development
- Significant resources dedicated to its review, maintenance, and updates on an ongoing basis

NEMS has been used by the EIA and others, both within and external to the government, for forecasting, planning and policy evaluation since 1994. Through its production of the Annual Energy Outlook reports as well as special studies, EIA keeps the data sources and model capabilities up-to-date to reflect the latest energy issues, trends, and policies. This allows OnLocation to examine and understand energy forecasts and their key drivers, build on the model's foundation, and customize the model to analyze specific policy issues and proposals. Having participated in a wide variety of analyses using NEMS for multiple clients, OnLocation has developed a seasoned perspective on the elements of long-term forecasting that impact analytic results.

Power Sector Modeling, Analysis, and Assessment

The electric generation sector is one of the most detailed and data rich modules within NEMS and can be used to analyze a broad range of policies within the power sector. The NEMS model includes a database of detailed information on individual power plants throughout the country, including operating costs and characteristics, plant configurations of installed environmental control equipment, and average emission rates for SO_2, NOx and mercury. The model also includes costs and characteristics for several compliance options available for power plants to

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meet air quality regulations. Compliance options include fuel switching to lower sulfur coal types, retrofit equipment options for all three pollutants, and a flexible cost-based dispatch algorithm. The model uses financial criteria to choose among these options or choose to retire a plant, considering the plant's heat rate, operating costs, system capacity reserve requirements and future fuel prices.

NEMS is also frequently used to analyze the impacts of policies to deploy clean energy technologies and reduce CO2 emissions. Studies performed by OnLocation range from specific proposed legislation of cap-and-trade policies, clean energy standards (CES), renewable portfolio standards (RPS), and clean energy incentives, as well as more explorative versions of these policies. CO_2 cap-and-trade policy options and specifications include an annual CO_2 allowance cap (economy-wide or by sector), allowance banking, marginal abatement curves and limits for both domestic and international CO_2 offsets, revenue recycling options, and allocation vs. auction of allowances. Model features designed for clean energy standards and renewable portfolio standards include an annual target expressed in percent of electricity sales, credit banking, and options for determining which technologies qualify for the program.

The Electricity Market Module (EMM) in NEMS consists of four sub-modules: the Electricity Capacity Planning Model (ECP), the Electricity Fuels and Dispatch Model (EFD), the Electricity Finance and Pricing Model (EFP) and the Load and Demand Side Management Module (LDSM).

The EMM projects new generation capacity, environmental control retrofits needed to meet current and proposed environmental regulations, and dispatch of generation and electricity prices for 22 NERC-based electricity regions. The model starts with a detailed database that includes key economic and technical performance characteristics (e.g., heat rates, capacity, pollution control technologies and emission rates, operating costs, etc.) of ***all*** existing power plants/units. In addition, the EMM is initialized with selected financial data that allows the estimation of cost-of-service based electricity prices in those regions where this is relevant. Given these initial conditions, the ECP assesses the need for new capacity in the context of the forecasted economic and regulatory environment. The EFD plant-level generation (i.e., unit dispatch) given the fuel and variable O&M costs, the relative efficiencies of the generating technologies, and the costs of meeting various environmental constraints (e.g., emission allowances). The EFP estimates the retail price of electricity under competitive market (marginal costs) and cost-of-service pricing regimes. The LDSM constructs load duration curves used by the ECP and EFD from the end-use demand levels estimated in other NEMS modules.

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Selected highlights of the EMM include:

- Constructs new capacity on a yearly basis to meet growing demand and reserve margin requirements, and chooses technologies appropriate for meeting future environmental and other policy requirements.
- Incorporates a market sharing algorithm to address cost uncertainty among a wide slate of competing technologies.
- Explicitly considers retrofits of pollution control technologies to existing plants as well as alternatives such as fuel switching or plant retirement to meet emission constraints, and provides detailed outputs regarding emissions (SO2 NOx, CO2).
- Explicitly considers expanding transmission interfaces between regions to allow for the greater use and sharing of regional energy potential (e.g., wind resources).
- Explicitly adjusts capacity needs for increased penetration of intermittent renewable generation.
- Accommodates different assumptions across a broad range of key factors, such as electric generating technology costs, end-use energy demand, fuel prices, etc.
- Explicitly addresses component learning on key electric generating technologies.
- Explicitly models the transport and storage of captured CO2 to saline storage (with detailed site-specific costs of storage).

OnLocation played a pivotal role in the design and implementation of the original EMM. In our ongoing role as support contractor to EIA, we continue to make major contributions to improving technology representation and extending the EMM's ability to address the evolving state and national policy initiatives along with market and operational issues facing the power industry. For example, we incorporated spinning reserve requirements and heat rate curves for coal where the efficiency declines with lower usage.

One the most recent enhancements to the EMM is the inclusion of utility scale storage that is challenging to represent in large scale models. OnLocation provided EIA with an innovative solution to the representation of battery storage within the EMM context where a high temporal resolution is not feasible. Rather than expanding the number of representative load slices in the entire capacity expansion and dispatch routines, a new submodule was created. This submodule performs an hourly dispatch using data provided by the rest of the EMM including hourly load requirements, wind and solar generation patterns hydroelectric capacity and monthly generation potential, and cost of conventional power generation. The dispatch is performed with existing storage and then with additional storage to determine the arbitrage value of storage, wind and solar curtailments and the timing of hydrogenation. These values are passed back to the EMM to inform the capacity expansion and final dispatch decisions.

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Carl Pechman

From: Kathryn Kline
Sent: Wednesday, August 14, 2019 10:35 AM
To: Carl Pechman
Subject: RE: Updated List of Attorneys & Law Firms

I have not had business dealings with any of the groups listed in the attachment.

Kathryn

Kathryn Kline
Senior Research Associate
National Regulatory Research Institute
1101 Vermont Avenue, NW, Suite 200
Washington, D.C. 20005
(202) 222 0377

From: Carl Pechman
Sent: Wednesday, August 14, 2019 9:49 AM
To: Kathryn Kline <kkline@nrri.org>; Sherry Lichtenberg <slichtenberg@nrri.org>; Tom Stanton <tstanton@nrri.org>
Subject: FW: Updated List of Attorneys & Law Firms

All,

The meeting with the SC commission went well on Monday. They have asked us to pursue a more extensive conflict check. Please look over the attached list, and the two following companies and let me know if you have had any business dealings with any of the entities.

- Ecoplexus, Incorporated
- Central Electric Power Cooperative, Incorporated

Thanks,

Carl

From: Ellison, Afton [mailto:afton.ellison@psc.sc.gov]
Sent: Tuesday, August 13, 2019 1:02 PM
Subject: Updated List of Attorneys & Law Firms

Good Afternoon,

Please find attached an updated copy of the Attorneys, law firms, Intervenors, and subsequent Parties of Record for the Avoided Cost Methodology dockets. A spelling error for Attorney Belton Zeigler was discovered, and has been corrected.

We apologize for any confusion this may have caused.

Sincerely,

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Carl Pechman

From: Sherry Lichtenberg
Sent: Wednesday, August 14, 2019 10:01 AM
To: Carl Pechman; Kathryn Kline; Tom Stanton
Subject: RE: Updated List of Attorneys & Law Firms

I have not had any business with any of these parties.

Sherry

From: Carl Pechman
Sent: Wednesday, August 14, 2019 9:49 AM
To: Kathryn Kline <kkline@nrri.org>; Sherry Lichtenberg <slichtenberg@nrri.org>; Tom Stanton <tstanton@nrri.org>
Subject: FW: Updated List of Attorneys & Law Firms

All,

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- Central Electric Power Cooperative, Incorporated

Thanks,

Carl

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Good Afternoon,

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We apologize for any confusion this may have caused.

Sincerely,

Afton

Afton Ellison
Public Service Commission of SC
101 Executive Center Drive, Suite 100
Columbia, SC 29210

803.896.5205 (Office)
803.896.5199 (Fax)

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Carl Pechman

From: Kathryn Kline
Sent: Wednesday, August 14, 2019 9:53 AM
To: Sherry Lichtenberg; Carl Pechman; Tom Stanton
Subject: RE: Updated List of Attorneys & Law Firms

Congrats on the successful meeting with SC! I have not had business dealings with any of the groups listed in the attachment.

Kathryn

From: Sherry Lichtenberg
Sent: Wednesday, August 14, 2019 9:52 AM
To: Carl Pechman <cpechman@nrri.org>; Kathryn Kline <kkline@nrri.org>; Tom Stanton <tstanton@nrri.org>
Subject: RE: Updated List of Attorneys & Law Firms

I know Nanette Edwards, the lead on the SC Regulatory staff. She used to be a member of the NARUC telecom committee.

I don't know any of the others – and have never even been in a Walmart.

Sherry

From: Carl Pechman
Sent: Wednesday, August 14, 2019 9:49 AM
To: Kathryn Kline <kkline@nrri.org>; Sherry Lichtenberg <slichtenberg@nrri.org>; Tom Stanton <tstanton@nrri.org>
Subject: FW: Updated List of Attorneys & Law Firms

All,

The meeting with the SC commission went well on Monday. They have asked us to pursue a more extensive conflict check. Please look over the attached list, and the two following companies and let me know if you have had any business dealings with any of the entities.

- Ecoplexus, Incorporated
- Central Electric Power Cooperative, Incorporated

Thanks,

Carl

From: Ellison, Afton [mailto:afton.ellison@psc.sc.gov]
Sent: Tuesday, August 13, 2019 1:02 PM
Subject: Updated List of Attorneys & Law Firms

Good Afternoon,

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Sincerely,

Afton

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Carl Pechman

From: Jeffrey Loiter <loiterwork@gmail.com>
Sent: Wednesday, August 14, 2019 10:35 AM
To: Carl Pechman
Subject: Re: Updated List of Attorneys & Law Firms

Glad to hear that. No, no dealings with either of those.

-Jeff

Jeffrey Loiter
(802) 238-9827 (mobile)
loiterwork@gmail.com

Linkedin profile

On Aug 14, 2019, at 9:48 AM, Carl Pechman <cpechman@nrri.org> wrote:

Jeff,

The meeting with the SC commission went well on Monday. They have asked us to pursue a more extensive conflict check. Please look over the attached list, and the two following companies and let me know if you have had any business dealings with any of the entities.

- Ecoplexus, Incorporated
- Central Electric Power Cooperative, Incorporated

Thanks,

Carl

From: Ellison, Afton [mailto:afton.ellison@psc.sc.gov]
Sent: Tuesday, August 13, 2019 1:02 PM
Subject: Updated List of Attorneys & Law Firms

Good Afternoon,

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Sincerely,

Afton

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<Parties and Attorneys_Avoided Cost Dockets.pdf>

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Carl Pechman

From: Elliott J. Nethercutt <elliott.nethercutt@gmail.com>
Sent: Wednesday, August 14, 2019 3:20 PM
To: Carl Pechman
Subject: Re: Updated List of Attorneys & Law Firms

Hi Carl,

I'm glad to hear the meeting went well. Upon further review, I have had no direct business dealings during my career with any of the listed entities. While some of those entities had to comply with select NERC Reliability Standards, I was in the Reliability Assessment division and was not directly involved with Compliance or Compliance Enforcement.

Elliott

Sent from my mobile device.

On Aug 14, 2019, at 6:47 AM, Carl Pechman <cpechman@nrri.org> wrote:

> Elliott,
>
> The meeting with the SC commission went well on Monday. They have asked us to pursue a more extensive conflict check. Please look over the attached list, and the two following companies and let me know if you have had any business dealings with any of the entities.
>
> - Ecoplexus, Incorporated
> - Central Electric Power Cooperative, Incorporated
>
> Thanks,
>
> Carl
>
> ---
>
> **From:** Ellison, Afton [mailto:afton.ellison@psc.sc.gov]
> **Sent:** Tuesday, August 13, 2019 1:02 PM
> **Subject:** Updated List of Attorneys & Law Firms
>
> Good Afternoon,
>
> Please find attached an updated copy of the Attorneys, law firms, Intervenors, and subsequent Parties of Record for the Avoided Cost Methodology dockets. A spelling error for Attorney Belton Zeigler was discovered, and has been corrected.
>
> We apologize for any confusion this may have caused.
>
> Sincerely,
>
> Afton
>
> Afton Ellison

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Carl Pechman

From: Theresa Flaim <flaim_t@msn.com>
Sent: Wednesday, August 14, 2019 9:58 AM
To: Carl Pechman
Cc: Bernie Neenan
Subject: RE: Updated List of Attorneys & Law Firms

Carl, I haven't had any business dealings with any of the firms on your list.

Theresa Flaim
5524 Heathrow Drive
Knoxville, TN 37919
H: 865-909-0535
C: 865-406-9433

From: Carl Pechman <cpechman@nrri.org>
Sent: Wednesday, August 14, 2019 9:47 AM
To: Bernard F. Neenan <Neenan_B@msn.com>; Theresa Flaim <flaim_t@msn.com>
Subject: FW: Updated List of Attorneys & Law Firms

Bernie and Theresa

The meeting with the SC commission went well on Monday. They have asked us to pursue a more extensive conflict check. Please look over the attached list, and the two following companies and let me know if you have had any business dealings with any of the entities.

- Ecoplexus, Incorporated
- Central Electric Power Cooperative, Incorporated

Thanks,

Carl

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Carl Pechman

From: Tom Stanton
Sent: Wednesday, August 14, 2019 5:40 PM
To: Carl Pechman; Kathryn Kline; Sherry Lichtenberg
Subject: Re: Updated List of Attorneys & Law Firms

On Aug 14, 2019, at 10:45 AM, Tom Stanton <tstanton@nrri.org> wrote:

> I looked at the whole list. I have no business dealings to report with any of those companies or individuals listed.
>
> Tom Stanton, Principal Researcher for Energy and Environment
> National Regulatory Research Institute -- www.nrri.org
> Direct voice/office/mobile/sms = 517-775-7764, 9a-5p, M-F
> tstanton@nrri.org -- www.linkedin.com/in/tsstanton/

From: Carl Pechman
Sent: Wednesday, August 14, 2019 9:49 AM
To: Kathryn Kline <kkline@nrri.org>; Sherry Lichtenberg <slichtenberg@nrri.org>; Tom Stanton <tstanton@nrri.org>
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Carl Pechman

From: Bernard F. Neenan <Neenan_B@msn.com>
Sent: Wednesday, August 14, 2019 12:45 PM
To: Carl Pechman; Theresa Flaim
Subject: RE: Updated List of Attorneys & Law Firms

Carl-
I consulted with South Carolina Gas and Electric on electric rates in the early 1990 and at EPRI worked with several researchers at Duke on Smart Grid projects in 2008-16.

From: Carl Pechman <cpechman@nrri.org>
Sent: Wednesday, August 14, 2019 9:47 AM
To: Bernard F. Neenan <Neenan_B@msn.com>; Theresa Flaim <flaim_t@msn.com>
Subject: FW: Updated List of Attorneys & Law Firms

Bernie and Theresa

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